TURBINE SECTION OF HIGH BYPASS TURBOFAN

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This is a Continuation-in-Part application of Ser. No. 11/832,107, filed Aug. 1, 2007, and entitled "Engine Mounting Configuration for a Turbofan Gas Turbine Engine" and benefit is claimed of U.S. Patent Application Ser. No. 61/593,190, filed Jan. 31, 2012, and entitled "Tubine Section of High Bypass Turbofan" and U.S. Patent Application Ser. No. 61/498,516, filed Jun. 17, 2011, and entitled "Turbine Section of High Bypass Turbofan", the disclosures of which are incorporated by reference herein in their entireties as if set forth at length.

BACKGROUND

[0002] The disclosure relates to turbofan engines. More particularly, the disclosure relates to low pressure turbine sections of turbofan engines which power the fans via a speed reduction mechanism.

[0003] There has been a trend toward increasing bypass ratio in gas turbine engines. This is discussed further below. There has generally been a correlation between certain characteristics of bypass and the diameter of the low pressure turbine section sections of turbofan engines.

SUMMARY

[0004] One aspect of the disclosure involves a turbofan engine having an engine case and a gaspath through the engine case. A fan has a circumferential array of fan blades. The engine further has a compressor in fluid communication with the fan, a combustor in fluid communication with the compressor, a turbine in fluid communication with the combustor, wherein the turbine includes a low pressure turbine section. A speed reduction mechanism couples the low pressure turbine section to the fan. A bypass area ratio is greater than about 6.0. A ratio of the total number of airfoils in the low pressure turbine section divided by the bypass area ratio is less than about 170.

[0005] In additional or alternative embodiments of any of the foregoing embodiments, the bypass area ratio may be greater than about 8.0 or may be between about 8.0 and about 20.0.

[0006] In additional or alternative embodiments of any of the foregoing embodiments, a fan case may encircle the fan blades radially outboard of the engine case.

[0007] In additional or alternative embodiments of any of the foregoing embodiments, the compressor may comprise a low pressure compressor section and a high pressure compressor section.

[0008] In additional or alternative embodiments of any of the foregoing embodiments, the blades of the low pressure compressor section and low pressure turbine section may share low shaft.

[0009] In additional or alternative embodiments of any of the foregoing embodiments, the high pressure compressor section and a high pressure turbine section of the turbine may share a high shaft.

[0010] In additional or alternative embodiments of any of the foregoing embodiments, there are no additional compressor or turbine sections.

[0011] In additional or alternative embodiments of any of the foregoing embodiments, the speed reduction mechanism may comprise an epicyclic transmission coupling the low speed shaft to a fan shaft to drive the fan with a speed reduction.

[0012] In additional or alternative embodiments of any of the foregoing embodiments, the low pressure turbine section may have an exemplary 2 to 6 blade stages or 2 to 3 blade stages.

[0013] In additional or alternative embodiments of any of the foregoing embodiments, a hub-to-tip ratio (R_I:R_O) of the low pressure turbine section may be between about 0.4 and about 0.5 measured at the maximum R_O axial location in the low pressure turbine section.

[0014] In additional or alternative embodiments of any of the foregoing embodiments, a ratio of maximum gaspath radius along the low pressure turbine section to maximum radius of the fan may be less than about 0.55, or less than about 0.50, or between about 0.35 and about 0.50.

[0015] In additional or alternative embodiments of any of the foregoing embodiments, said ratio of low pressure turbine section airfoil count to bypass area ratio may be between is about 10 and about 150.

[0016] In additional or alternative embodiments of any of the foregoing embodiments, an airfoil count of the low pressure turbine section may be below about 1600.

[0017] In additional or alternative embodiments of any of the foregoing embodiments, the engine may be in combination with a mounting arrangement (e.g., of an engine pylon) wherein an aft mount reacts at least a thrust load.

[0018] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. **1** is an axial sectional view of a turbofan engine.

[0020] FIG. **2** is an axial sectional view of a low pressure turbine section of the engine of FIG. **1**.

[0021] FIG. **3** is transverse sectional view of transmission of the engine of FIG. **1**.

[0022] Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0023] FIG. **1** shows a turbofan engine **20** having a main housing (engine case) **22** containing a rotor shaft assembly **23**. An exemplary engine is a high-bypass turbofan. In such an engine, the normal cruise condition bypass area ratio of air mass flowing outside the case **22** (e.g., the compressor sections and combustor) to air mass passing through the case **22** is typically in excess of about 4.0 and, more narrowly, typically between about 4.0 and about 12.0. Via high **24** and low **25** shaft portions of the shaft assembly **23**, a high pressure turbine section (gas generating turbine) **26** and a low pressure turbine section **27** respectively drive a high pressure compressor section **28** and a low pressure compressor section **30**. As used herein, the high pressure turbine section experiences higher pressures that the low pressure turbine section. A low pressure turbine section is a section that powers a fan **42**. Although a two-spool (plus fan) engine is shown, one of many alternative variations involves a three-spool (plus fan) engine